Original document

DIESEL ENGINE OF LIGHTTOIL LUBRICATION TYPE

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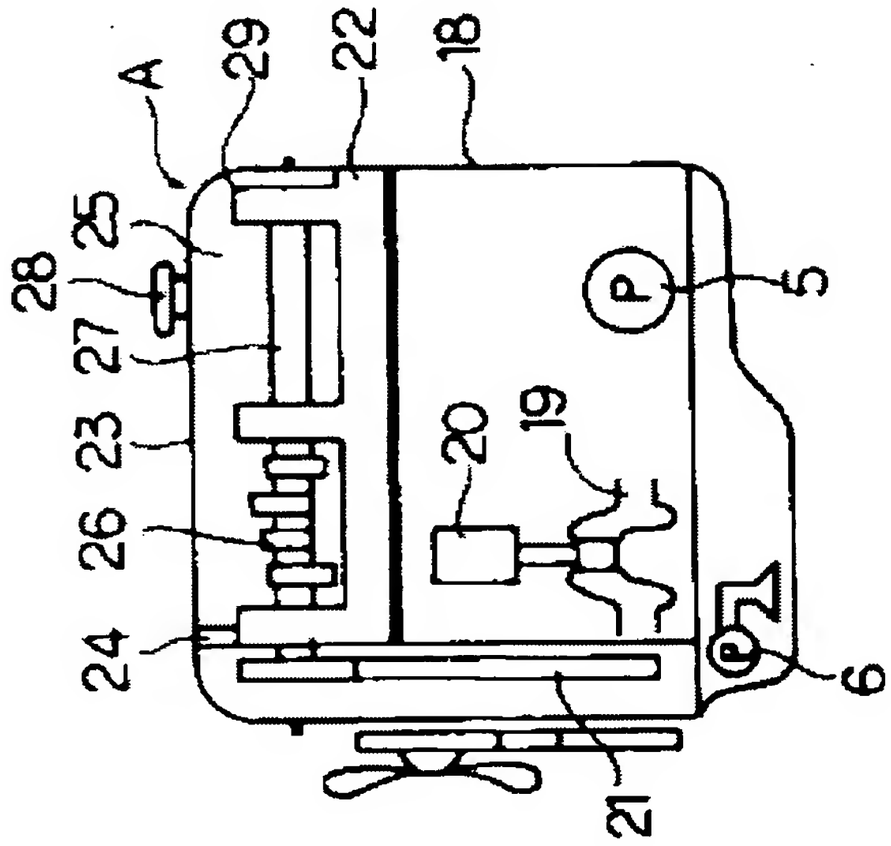
Abstract of **JP56027015**
PURPOSE:To lubricate each part effectively by a method wherein a lubrication system for the moving valve mechanism of a cylinder head and the main motion part, such as a crank shaft, is separated and the engine oil is used as a lubricant for the moving valve system in the device where the light oil for fuel is used as the lubricant for an engine.
CONSTITUTION:A lubricant (light oil) sent under pressure by a lubrication pump 5 arranged in a cylinder block 18 is sent, as before, to the main motion part, such as a crank shaft 19, a piston 20 and a timing chain 21, for lubrication of these slidable parts. On the other hand, the moving valve system of a cylinder head 22 is formed separately from the above lubrication system. That is, an oil-gathering chamber 25 composed of a locker cover 23 and a shield plate 24, etc. is formed in the upper part of the cylinder head 22 and filled with an engine oil so that the moving valve mechanism including a cam 26 and a cam shaft 27 is dipped up to a fixed height. Filling and supply of the oil are conducted by removing a filler cap 28.



Description of corresponding document: **US4392463**

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to diesel engines adapted to utilize diesel fuel as engine lubricant, and more specifically to a diesel engine having a dual lubrication system comprising a first system utilizing diesel fuel as engine lubricant and a second system utilizing conventional engine oil as engine lubricant.

2. Description of the Prior Art

With recent gradual tightening of emission control regulations, exhaust gas recirculation (EGR) systems have been added to diesel engines. However, since diesel engine exhaust gases contain a large amount of soot and sulfur, EGR systems accelerate the deterioration of engine lubricant oil, making it necessary to change the engine oil at more frequent intervals.

SUMMARY OF THE INVENTION

The dual lubrication system diesel engine of the present invention includes first and second independent lubricating systems. The first lubrication system, containing conventional engine oil, lubricates those parts of the engine that are subjected to excessive wear. The second lubrication system, utilizing diesel fuel as its lubricant, lubricates that section of the engine not subjected to extreme wear--the crankcase section. After serving as an engine crankcase lubricant, the diesel fuel is returned to the fuel tank to be used as diesel fuel to power the engine in the conventional manner. By not being exposed to engine crankcase blowby exhaust gas, the useful life of the engine oil in the first lubrication system is extended. By absorbing pollutants contained in the crankcase blowby exhaust gases, the diesel fuel recirculates those pollutants through the fuel system to be burned in the combustion chamber, thereby filtering these contaminates from the engine lubricant and eliminating lubrication changes in this crankcase section of the diesel engine.

It is accordingly an object of the present invention to provide a dual lubrication system diesel engine having a first lubrication system that prolongs the useful life of engine oil, and a second lubrication system that utilizes diesel fuel to lubricate that section of the engine and then reciculate such fuel through the fuel system to be burned and exhausted, thus eliminating lubricant changes in the crankcase section of the diesel engine.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the dual lubrication system diesel engine of the present invention will be more clearly appreciated from the following description taken in conjunction with the accompanying drawings in which like reference numerals designate corresponding elements, and in which:

FIG. 1 is a block diagram of the elements of a diesel engine adapted to utilize diesel fuel as an engine lubricant with which the present invention is concerned;

FIG. 2 is a sectional diagrammatical view of a dual lubrication system diesel engine of the present invention; and

FIG. 3 is a sectional view of a second embodiment of the engine oil lubrication system of the dual lubrication system diesel engine of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, and more specifically to FIG. 1, a diesel engine adapted to utilize diesel fuel as engine lubricant is shown in block diagram form. Diesel fuel (or diesel fuel mixed with engine oil) is contained in a fuel tank 1, to be drawn therefrom by a fuel pump 2 and pumped through an oil/water separator 3 and a first fuel filter 4a. From this first fuel filter 4a, diesel fuel separates into two paths: one to a second fuel filter 4b, a fuel injection pump 10, a fuel injection nozzle 11 and into the engine combustion chamber 12; and the other into the lubrication system of the engine via a lubrication pump 5. This

lubrication pump 5 circulates the diesel fuel within the engine to lubricate the various moving mechanical parts thereof--the crankshaft, pistons, connecting rods, etc. This diesel fuel having lubricated these various mechanical moving parts is then collected in the oil pan and withdrawn therefrom by a suction pump 6, pumped through an air trap filter 7, a return pump 8, a fuel cooling device 9 and returned to the fuel tank 1.

Excess fuel overflow from the fuel injection pump 10 and the fuel injection nozzle 11 is collected and drained into the engine via an injection pump line 13 and injection nozzle line 14, respectively, to be used as engine lubricant. Any fuel vapor trapped in the engine, the air trap filter 7 or the fuel tank 1 passes through respective ventilation lines 15, 16 and 17 through the engine intake manifold and into combustion chamber 12 to be burned and exhausted.

It should be apparent to those skilled in the art that the diesel engine described hereinabove never requires oil changes because the entire engine is lubricated by diesel fuel which is collected and returned to the fuel tank after having served as a lubricant, to then be used as diesel fuel in the conventional manner. However, in some types of diesel engines, certain of the mechanical moving parts therein are subjected to extreme conditions of accelerated wear, thus requiring a lubricant having a film strength much higher than that of diesel fuel--typically the valve train comprising the cam shaft, rocker arms, valve lifters, etc. With this in mind, the dual lubrication system diesel engine of the present invention is diagrammatically shown in FIG. 2 to comprise a first lubrication system 20 for lubricating a first section of the engine with conventional engine oil, and a second lubrication system 22 for lubricating the remaining section of the diesel engine with diesel fuel, as in the engine described hereinabove. In the preferred embodiment, the first lubrication system 20 using conventional engine oil is of the oil bath type for lubricating that section of the engine subjected to excessive wear. It is shown in FIG. 2 to comprise an oil bath reservoir 24 defined by the upper portion of the engine cylinder head 26. In this embodiment of the dual lubrication system diesel engine, the engine is of an overhead cam type, having a valve train 28, comprising a cam 30, camshaft 32, etc., positioned on the top part of the cylinder head 26 within the oil bath reservoir 24 to be immersed in engine lubricant contained within the oil bath reservoir. An engine rocker arm cover 34 and cover plate 36 also cooperate with the upper portion of the cylinder head 26 to further define the totally enclosed oil bath reservoir 24.

In this embodiment, that section of the diesel engine subjected to excessive wear is the valve train 28; therefore, the first lubrication system 20 utilizes conventional engine oil having a film strength higher than that of diesel fuel as the lubricant.

The second lubrication system 22 is totally separate and independent of the first lubrication system 20, and is essentially the same as that described hereinabove in connection with FIG. 1. The second lubrication system 22 utilizes diesel fuel as the engine lubricant to lubricate those moving mechanical parts of the diesel engine that are not subjected to excessive wear--the engine crankshaft 42, pistons 44, connecting rods 46, timing chain 48, etc. As in the diesel engine described in connection with FIG. 1, the second lubrication system 22 lubricates this specific section of the engine with diesel fuel, and then collects this diesel fuel having been used as an engine lubricant and returns it via the suction pump 6, air trap filter 7, return pump 8 and cooling device 9 to the fuel tank 1 to be used as diesel fuel to power the diesel engine in the conventional manner.

In addition to the diesel fuel serving as an engine lubricant for those moving mechanical parts of the diesel engine not subjected to excessive wear, the diesel fuel also serves as an aid to the EGR system of the diesel engine. Engine lubricant (diesel fuel in the diesel engine of the present invention) being exposed to exhaust gases during lubrication of the crankcase section of the engine, collects soot, sulfur and other exhaust gas pollutants, and recirculates them through the fuel system for more efficient burning in the engine combustion chamber, thus reducing the amount of pollutants released into the atmosphere through engine exhaust.

Since this process of circulating diesel fuel through the main moving mechanical parts of the engine to serve as lubricant therefore is continuous, the main engine parts are constantly lubricated by substantially fresh uncontaminated lubricant. Additionally, since the pollutant recirculation effect of the diesel fuel used as engine lubricant is continuous, there is no chance for pollutants to build up within the diesel fuel/lubricant or otherwise saturate the diesel fuel therewith. Consequently, the diesel fuel/lubricant never needs changing, because of the fact that it is continually being "changed" and replaced with fresh diesel fuel/lubricant, at the same time providing a filtering effect to recirculate pollutants through the engine for

more efficient burning thereof, which pollutants would otherwise contaminate the engine lubricant and severely reduce its effectiveness to provide a lubricating film between moving parts of the diesel engine, to protect them from excessive wear.

The first lubrication system 20 lubricates those moving parts of the diesel engine that are subjected to excessive wear. Therefore, the first lubrication system 20 utilizes conventional engine oil as its lubricant. In this embodiment of the dual lubrication system diesel engine of the present invention, conventional engine oil in the first lubrication system 20 lubricates only the valve train 28, and is therefore not exposed to engine exhaust gases, as is the diesel fuel/lubricant used in the second lubrication system 22. Those skilled in the art will readily appreciate that the life of the engine oil can be substantially prolonged due to the fact that it is not exposed to blowby exhaust gas in the engine crankcase or to excessive combustion chamber heat, which tend to contaminate and to deteriorate engine lubricant used to lubricate the crankcase portion of internal combustion engines. Additionally, the first lubrication system 20 of the dual lubrication system diesel engine of the present invention is an oil bath type, which has the beneficial effect of absorbing engine valve train noise, resulting in a quieter engine.

A second embodiment of the dual lubrication system diesel engine of the present invention is shown in FIG. 3 comprising an oil pump 50, rotatably mounted to support the cam shaft 32. The pump 50 comprises a combination camshaft support bracket and pump housing 52 having a pump element 54 therein. In this second embodiment, the pump element 54 is of a trochoid design, and is attached to the cam shaft to rotate therewith to suck oil from the oil bath reservoir 24 through an oil intake passage 56, and pump this oil through an oil delivery passage 58, an annular oil passage 62 and a radial passage 60 formed in the end section or bearing of the cam shaft 32, and through the cam shaft axial oil gallery 64 to be pumped to each of the cam shaft lobes 30 for lubricating the valve lifters, rocker arms, valve stems, etc. in the conventional manner.

In this second embodiment, as in the preferred embodiment, the lubricating oil used in the first lubrication system 20 is enclosed within the reservoir 24 defined by the upper portion of the cylinder head 26 and the rocker arm cover 34. After lubricating the various members of the valve train 28, the oil is collected in the oil bath reservoir 24 for recirculation through the first lubrication system 20 as outlined hereinabove. In this manner, the first lubrication system 20 functions separately and independently of the second lubrication system 22 which utilizes diesel fuel to lubricate the remaining mechanical moving parts of the diesel-engine--the crank shaft, pistons, connecting rods, etc.

Claims of corresponding document: **US4392463**

What is claimed is:

1. A method of lubricating the working parts of a diesel engine equipped with an exhaust gas recirculation system, said working parts including a valve train whose lubricant is substantially prevented from being exposed to exhaust gases and other working parts whose lubricant may be exposed to exhaust gases, said method comprising: lubricating the engine working parts except for the valve train with diesel fuel; using the diesel fuel after the same has served as a lubricant for fuel for the engine; and lubricating the valve train with a separate lubrication system.

2. A diesel engine equipped with an exhaust gas recirculation system and having working parts including a valve train whose lubricant is substantially prevented from being exposed to exhaust gases and other working parts whose lubricant may be exposed to exhaust gases, said engine comprising: a first lubrication system for lubricating the working parts except for the valve train with diesel fuel; a fuel system fluidly connected with said first lubrication system for supplying diesel fuel to the first lubrication system, and then using the diesel fuel, which has served as a lubricant, for fuel for the engine; and a second lubrication system independent of the first lubrication system for lubricating the valve train.

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発明の数　1

審査請求　未請求

（全 4 頁）

⑤4軽油潤滑式ディーゼルエンジン

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⑦1特　　願　昭54—101833

⑦2出　　願　昭54(1979) 8 月10日

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発明の名称

軽油潤滑式ディーゼルエンジン

特許請求の範囲

1. 燃料用ディーゼル軽油をエンジン潤滑油として用いるディーゼルエンジンにおいて、シリンダヘッドの動弁機構の潤滑系統と、クランク軸など主運動部の潤滑系統を分離して設け、動弁系の潤滑油としてはエンジンオイルを用いるようにしたことを特徴とする軽油潤滑式ディーゼルエンジン。

2. 前記シリンダヘッドにおける動弁潤滑系統をオイルパス構造とした特許請求の範囲第1項記載の軽油潤滑式ディーゼルエンジン。

3. 前記動弁機構のカムシャフトブラケットにオイルポンプを取りつけ、カムシャフトで直接駆動することを特徴とする特許請求の範囲第1項記載の軽油潤滑式ディーゼルエンジン。

4. 前記カムシャフトブラケットに油通路を加工し、油ポンプの取入口,およびカムシャフトへの送油孔としたことを特徴とする特許請求の範囲第3項記載の軽油潤滑式ディーゼルエンジン。

発明の詳細な説明

本発明は、燃料用軽油を潤滑油として利用するディーゼルエンジンに関する。

昨今の排気規制でディーゼルエンジンにおいても、NOx低減の意味から排気還流システムであるEGRが不可避となつてきた。

ところが、ディーゼルエンジンでは排気中に含まれるカーボン（煤）や硫黄が多大なため、このままEGRを行なうと潤滑剤としてのエンジンオイルがすぐに劣化してしまい潤滑油の交換頻度が増加するという問題があつた。

そこで、本出願人は先に上記問題解決のため、エンジンオイルの代わりに燃料の軽油を潤滑油として用いるエンジンを提案した（特願昭53—154480号）。

これは第1図に示すように、燃料タンク1には燃料としての軽油（又は、軽油と潤滑油の混合燃料）と入れるが、これを送油ポンプ2、油水分離

器３、フイルタ４ａ，４ｂを経てエンジン本体Ａの潤滑のための潤滑ポンプ５を経る潤滑系と、噴射ポンプ１０、噴射ノズル１１を経て燃焼室１２に噴射される燃料系に分流するようになつている。

そして、エンジン本体Ａ内で動弁機構及びクランク軸などの主運動部を潤滑してオイルパン内に溜つた油は、スカベンジングポンプ６により吸出されて気泡分離器７、ポンプ８、冷却器９を経て燃料タンク１に戻される。

噴射ポンプ１０のオーバーフロー燃料及び噴射ノズル１１のスピル油は通路１３，１４を介してエンジン本体Ａ内に潤滑油として与えられる。

又、エンジン本体Ａ、気泡分離器７あるいは燃料タンク１において分離された燃料蒸気はベンチレーション通路１５，１６，１７よりインテークマニホールドを介して燃焼室１２に与えられるようになつている。

しかしながら、このようなディーゼルエンジンにあつてはエンジン全体を一つの燃料タンクから送出される軽油潤滑とし、汚損された潤滑油は順

次燃料タンクに戻され消費されるようになつているため潤滑油の交換が不要となる反面、摺動部の中で比較的面圧の高いカムやロッカー等においては、軽油では油膜（粘性）が弱く、潤滑が不十分となつて摩耗が生じやすくなるという問題が生じた。

本発明はかかる点に鑑み提案されたもので、潤滑系統を分離して面圧が高いカム等動弁系にのみ通常の潤滑油を給油するように構成し、効果的に潤滑が行なえるようにした軽油潤滑式ディーゼルエンジンを提供することを目的とする。

以下、本発明の実施例を添附図面に基づいて説明する。

第２図はエンジン本体Ａの断面図であり、その他の燃料供給系及び潤滑系は第１図と同様であるため同一部材には同一符号を用いてその説明は省略する。

本発明の特徴は、エンジン本体Ａの潤滑系統を二つに分離したことにある。

即ち、シリンダブロック１８に配設された潤滑

ポンプ５を介して送られる潤滑油（軽油）は、シリンダブロック１８の内部つまり、クランクシャフト１９やピストン２０及びタイミングチエーン２１等に送られ、従前通りそれらの摺動部の潤滑を行うが、シリンダヘッド２２の動弁系には供給されないようになつている。

シリンダヘッド２２の上部には、ロッカカバー２３及び遮蔽板２４等から油溜め室（オイルパス）２５が形成され、その内部にカム２６及びカムシャフト２７等の動弁機構が所定の高さまで浸されるようエンジンオイルが充填されている。従つて、シリンダヘッド２２の動弁系は独立した潤滑機能を有している。

また、シリンダヘッド２２にはシリンダブロック１８側への油おとし機構がないため油溜め室25のエンジンオイルはほとんど減ることがないが、もし吸排気弁のステム摺動面から油下がりなどを生じて油が不足してくれば、ロッカカバー２３の上面に設けたフイラーキャップ２８を介して補給される。

このようにこの実施例によれば、クランクシャフト１９等の主運動部は従前通りの潤滑となり、つまり潤滑ポンプ５により燃料の一部の軽油が潤滑油として供給される一方、シリンダ内壁とピストン２０の摺動面を潤滑し排気ガスと接触して煤などを吸収しオイルパンに溜つた潤滑油がスカベンジングポンプ６を介して燃料タンク１に戻され、再び燃料として順次消費される。結果的には汚損された潤滑油は残らないことになる。

これにより、第１図と同様主運動部の潤滑において燃焼ガスとの接触により劣化しやすいエンジンオイルを使用せずに各摺動部の潤滑が行なえる。

一方、線接触になるカム２６及び点接触になるバルブチップ（図示せず）等最も面圧の高い部品を有する動弁機構は、シリンダヘッド２２に形成した油溜め室２５内の粘性の高いエンジンオイルによつて独立して潤滑される。

これにより、従来の全てを軽油潤滑する構造では防ぎきれなかつた動弁機構の摩耗を防止（減らす）できる。

また、これらシリンダヘッド２２の潤滑部にはオイルを劣化させる要因（排気ガスとの接触等）がないので、オイルは半永久的に使えるという利点がある。

更に、この実施例ではシリンダヘッド２２側はオイルバス式であるため、動弁機構のタペット系が油の中に入つてしまうので騒音を低減することにもなる。

尚、上記動弁機構の潤滑はオイルバス式に限られるわけではなく、動弁機構に潤滑系路を形成し、かつカムシャフト２７とカムシャフトブラケット２９の一部をポンプ機構とする（あるいは外部にポンプを別設する）送油ポンプで潤滑を行なうようにしても良い。

第３図に示すものは端部の、カムシャフトブラケット２９に油ポンプとしてトロコインポンプ30をとりつけた例である。油はカムシャフトブラケット２９内に設けた油取入口３４より通路３５を通つてポンプ（トロコイドギヤー）３１に吸い込まれ、出口３２よりカムシャフトジャーナル部に

圧送される。ジャーナル部にはグループ３６および通路３７が配設されており圧送されてきた油をカムシャフト２７の中心に設けられたオイルギャラリー３８へ送り出す。オイルギャラリー３８から後の給油は、現在広く用いられている方法と同じなので説明は除く。

なお、給油量が少ないのでポンプは小さなものでよく、また油が汚れないのでオイルフイルターも不要である。

以上説明したように本発明によれば、潤滑系統をオイル劣化を生じない動弁機構とオイル劣化しやすいクランク軸等の主運動部との二つに分離し、主運動部の潤滑は燃料の一部の軽油で行ない、動弁機構はエンジンオイルで潤滑するように構成したため、ＥＧＲなどにより劣化した潤滑油は燃料として燃焼させてしまうので、主運動部に常に新鮮な潤滑油を供給でき、また、高度の耐摩耗性を要求される部分はエンジンオイルで潤滑でき、このようにして各摺動部の潤滑を効果的に行ない、動弁系や主運動部の過度の摩耗を防止できる。

図面の簡単な説明

第１図は軽油潤滑式ディーゼルエンジンのシステム図、第２図は本発明のエンジン本体の断面図、第３図は本発明の他の実施例を示す断面図である。

２２…シリンダヘッド、２６…カム、２７…カムシャフト、２５…油溜め室、１９…クランクシャフト、２０…ピストン、５…潤滑ポンプ、２９…カムシャフトブラケット、３０…トロコイドポンプ、３５…油通路。

特許出願人　　日産自動車株式会社

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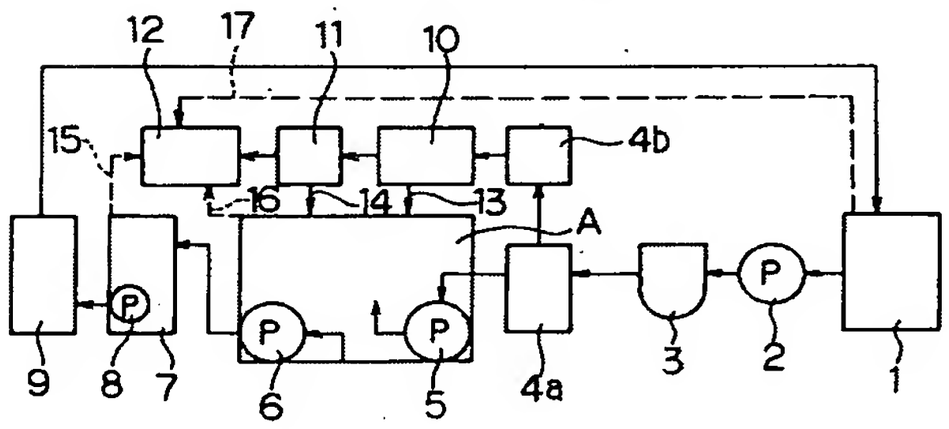
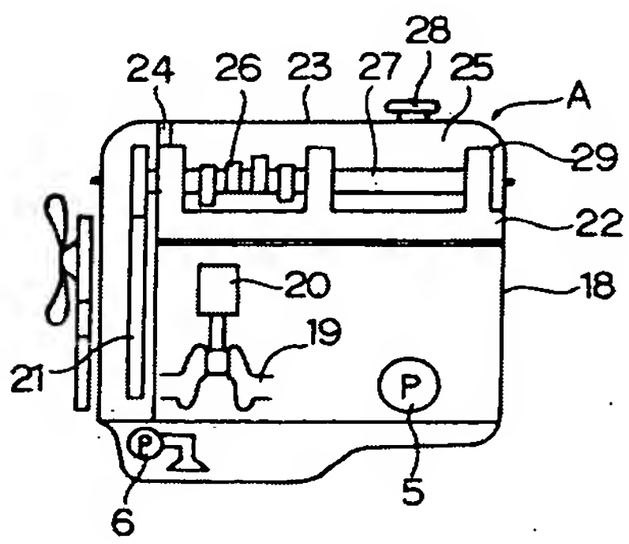
第１図



第２図



第 3 図